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NEW SPECIES OF PLANTS FROM THE MATAWAN FORMATION.

EDWARD W. BERRY.

IN A recent Bulletin of the New York Botanical Garden[1] I have enumerated sixty-seven species of plants from the Matawan formation (Mid-Cretaceous) describing fourteen species as new to science. Additional collections from near Cliffwood, New Jersey, the only locality within the formation where recognizable plant remains have been found, disclose numerous additions to this Flora, among which the following species have been singled out as new; and it has seemed best to publish them in advance of more extended treatment which might be long delayed. The remains are all from the lower portion of the Matawan formation known as the Crosswicks Clays. The types will be deposited in the paleobotanical collection of the New York Botanical Garden.

Confervites dubius sp. nov. Fig. 9.

Remains referable to this genus have not heretofore been recorded in this country, and as their microscopical characters are obliterated, it cannot be certain that they are algal in nature and not the macerated fibres of some higher plant. The disposition of the remains which are flexuous and interlaced would indicate the former view, and as a well marked type of vegetable remains they deserve a place in the flora of the Matawan formation. A number of foreign species have been referred to this genus,[2] comparisons with which would be useless in view of the unsatisfactory nature of the remains. Judging from the figured

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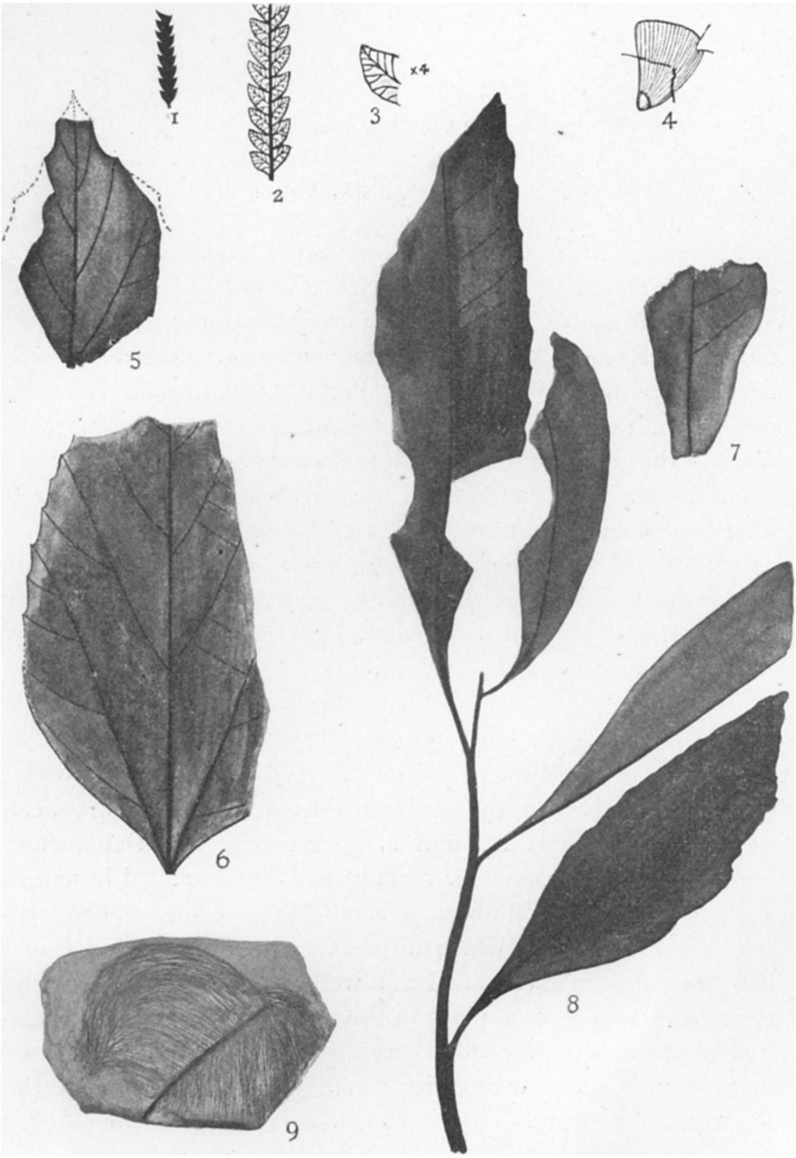
[1] Vol. 3. No. 9. Sept., 1903.

[2] Schimper, *Pal. Végét.* 1869, Tom 1, p. 154, lists eleven, mostly Tertiary species, all from European localities.



Figs. 1–3, *Gleichenia saundersii*; 4, *Pinus mattewanensis*; 5 and 6, *Viburnum hollickii*; 7 and 8, *Myrica heerii*; 9, *Confervites dubius*. Fig. 3 enlarged, all others four-fifths natural size.

specimen[1] our form is practically identical with that of *Confervites aquensis* Deb. & Ett., from the lower Senonian of Westphalia.

Gleichenia saundersii sp. nov. Fig. 1–3.

In the flora of the Matawan formation I called especial attention to the total absence of ferns in that formation. Recent collections contain three characteristic fragments of what I regard as a new species of Gleichenia, adding another to the considerable list of types common to the floras of the mid-cretaceous Atlantic coastal plain and that of Greenland. The larger fragments are each about 3 cm. long and 7 mm. wide and the smaller is 16 mm. long and 3 mm. wide. Pinnules broadly falcate-ovate, entire, bluntly pointed; attached by a wide base, about as wide as the pinnule is long; length 4.5 mm. ultimately becoming much smaller, each with a stout mid vein which sends off alternately on each side rather thick veins to the margin, those running distad are all simple except the basal one which is sometimes forked, those running proximad are usually once forked; texture thick and coriaceous.

Three species are found in the underlying Raritan formation, *Gleichenia gieseckiana* Heer is larger with longer narrower pinnules, *Gleichenia micromera* Heer is much smaller with narrow linear right-angled pinnules, and the widespread *Gleichenia zippei* Heer has narrower pinnules with more rounded apices.[2] The only other coastal plain species is the fragment which Hollick[3] refers to *Gleichenia gracilis* Heer, which is about the same size as the Cliffwood fern but has the pinnules more acute and runcinate. This reference of Hollick's was only provisional as he did not wish to found a species on so small a fragment. His specimen is quite distinct from the Matawan form and also seems to be distinct from Heer's type; unfortunately the venation cannot be made out. The numerous Greenland species have usually smaller pinnules; there is some similarity with *Gleichenia acutiloba* Heer, the venation being much the same, but the pinnules are smaller and more acute. The species is named for its discoverer Mr. B. H. Saunders of Clifton, N. J., who has collected a number of valuable specimens in the Clay-Marls.

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[1] Hos. & v. d. Marck, *Palaeont.* *26*: 177. pl. 36, f 135. 1880.

[2] Since the above was written small, poorly preserved fragments of the latter species have been detected in the Matawan formation by the writer.

[3] *Ann. N. Y. Acad. Sci.* Vol. 11, 1898, p. 57, pl. 3, f. 3.

The genus Gleichenia is a most interesting one. In the living flora it has about twenty-five species, widely distributed throughout the tropics of both hemispheres, subtropical eastern Asia, and the humid regions of the southern zone. The fossil species are equally numerous and widespread. Aside from those forms from the Paleozoic and older Mesozoic which have been referred to the Gleicheniaceæ, which reference is not altogether conclusive, as they probably represent synthetic forms from which the later species may have been derived, the genus enjoyed a wide adaptive radiation during the lower and middle Cretaceous. In the lower Cretaceous (Kome) of Greenland Heer has described fifteen species of Gleichenia, only one of which ranges as far south as the Potomac formation; one other occurs in the lower Cretaceous of the continental interior. By the mid-cretaceous several of these Greenland species had become wide-spread, identical species occurring in such widely separated localities as Europe and Kansas, or Europe, Greenland and New Jersey; four of the Greenland species find their way south along the Atlantic coastal plain and three reach Europe. Two species occur in the Laramie after which the species disappear. With the gradual refrigeration of Tertiary climates the Gleicheniaceæ moved southward, the only American fossil species of that age being the doubtful *Gleichenia obscura* Kn. from the late Tertiary (Esmeralda formation) of Nevada. This southern movement probably continued until Glacial times sending the Gleicheniaceæ into the West Indies, along the Andes into South America, along the eastern Asiatic coast, and across southern Europe into Africa.

Pinus mattewanensis sp. nov. Fig. 4.

The well characterized impression of a single winged seed is among the material from Cliffwood, N. J. Length 13.25 mm.;

greatest width 10.5 mm.; veins .75 mm. apart; proximal margin nearly straight; apex broadly truncate. Newberry[1] figures fragmentary winged seeds together with leaves from the underlying Raritan clays at South Amboy, N. J., and Hollick[2] figures leaf fragments and a single seed (Fig. 19) from Tottenville, Staten Island, in approximately synchronous strata, but no remains referable to this genus have hitherto been found in the Matawan formation. The specimen is unaccompanied by leaves although poorly characterized remains of the latter are found in the same formation. I have been unable to refer the seed to any described species, none of which are nearly so wide, and the same may be said of the existing species with which it has been compared. In outline it is approached by the seeds of some of our western species of Picea and it is also very similar to the seeds of *Cedrus deodara* Loud.

In the living gymnospermous Flora Pinus is a dominant genus with about seventy species widely distributed throughout the northern hemisphere, thirty-nine of these occurring within the limits of the United States. The fossil species are likewise numerous (though many are of uncertain value) ranging from the older Mesozoic upward. The genus becomes greatly developed in the later Cretaceous and early Tertiary of the Arctic regions, Greenland furnishing nine Cretaceous and six Eocene (?) species and Spitzbergen four Cretaceous and twelve Eocene (?) species, some of them widespread; thus *Pinus palæostrobus* (Ett.) Heer ranges from Switzerland and Tyrol to Florissant, Colorado, occurring in the Baltic Tertiary, in Greenland, Grinnell Land and Spitzbergen. *Pinus quenstedti* Heer is likewise cosmopolitan, occurring in the Cenomanian of Moravia, Silesia, and Bohemia, in Spitzbergen, in the Dakota group of Kansas, and in the Montana formation of Wyoming. *Pinus* (*Cyclopitus*) *nordenskioldi* Heer ranges from the Rhetic beds of Norway and Spitzbergen to the Kootanie of British Columbia.

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[1] *U. S. Geol. Survey*, Monograph 26, 1896, p. 48, pl. 9, figs. 17, 18.

[2] *Trans. N. Y. Acad. Sci.* Vol. 12, 1892, p. 4, pl. 1, figs. 13, 19, 20, 22.

Myrica heerii sp. nov. Figs. 7, 8.

This is one of the finest specimens that I have found in the Matawan formation, consisting of a twig and four attached leaves which are complete except for their apical portions; the block of clay in which they were found contains several more of these leaves which cannot be uncovered without destroying the specimen figured. The remains indicate a lanceolate leaf 13–14 cm. long by 2.7 cm. in greatest breadth; base tapering, narrow, gently incurved; the larger leaves have wide and regular, strongly undulate, almost toothed margins; two of the leaves are only slightly over one third the size of the larger and have entire margins; petioles comparatively long and moderately stout; leaf substance thick, with apparently immersed venation, as only a few secondaries can be made out on the impression of the under side of the largest leaf; they leave the midrib at a wide angle and are nearly straight almost to the margin where they fork at a wide angle; their ultimate disposition cannot be made out. The general similarity of size, shape and margin ally these leaves to Myrica. Seven species occur in the underlying Raritan clays, all of which are much smaller except *Myrica emarginata* Heer which approaches our smaller leaves in size; it is emarginate however and has entire margins and more ascending secondaries. Three species have been found in the Staten Island Cretaceous, one of which *Myrica hollicki* Ward is even larger than our leaf, which it resembles greatly except that the margin is more dentate. This species (*hollicki*) might be considered ancestral to the widespread Tertiary *Myrica banksiæfolia* Unger which in turn was considered by Lesquereux as the possible ancestor of the living *Myrica californica* Cham. of the Western United States. The latter might easily be the descendant of our Matawan leaf, some specimens seen by me are identical except for their slightly smaller size; other specimens are more dentate; no other living species that I have seen so nearly approaches the Matawan species in the character of the undulations of the margin, although nearly all of the Myricaceæ are very variable in this respect, the same species often having entire, or undulate, or dentate leaves on the same twig; this is particularly so in our common *Myrica cerifera* Linn. which might also be derived from the Matawan species. It is at least related and except for its somewhat smaller size and the irregular nature of the marginal characters it is strictly comparable.

The Cliffwood leaf is also very similar to *Myrica* (?) *trifoliata* Newb.[1] in size, shape and margin, but is longer petioled and not trifoliate. Among the ten species found in the Dakota group are several approaching ours in size, the one most similar, *Myrica aspera* Lesq.[2] has the same texture, size and margin; the base of the former is however narrower, the venation more obsolete, the midrib more slender, and the petiole considerably longer if we may judge from Lesquereux's figure which appears to be that of a sessile leaf. This species has also been mentioned as the possible ancestor of the living *Myrica cerifera* Linn.

Myrica torreyi Lesq. is the possible descendant of *Myrica heerii* in the Montana and Laramie formations, with more pronounced marginal teeth. A number of unrelated Cretaceous leaves are somewhat similar in form and margin, as for instance *Ilex borealis* Heer, *Elæodendron speciosum* Lesq., and *Rhus powelliana* Lesq., but all differ in other particulars. Another species from the Dakota group which resembles our leaf is referred by Lesquereux to the somewhat smaller leaved species *Proteoides acuta* Heer. Like the Matawan leaf this also contains smaller entire margined leaves, but the tip is more extended, the undulations of the margin are wider, and the base indicates that the leaves were sessile.

Viburnum hollickii sp. nov. Figs. 5, 6.

Viburnum whymperi Heer, Knowlton, *Bull. U. S. Geol. Surv.* 163. pl. 19, f. 3. 1900 (*non* pl. 17 f. 1, and pl. 18 f. 1).

The remains consist of the major portions of several leaves indicating an ovate leaf between nine and ten centimeters in length by 5 cm. in greatest breadth; apex and base acute; basal secondaries opposite, long, ascending in a nearly straight line from the decurrent base, giving off three or four tertiaries on the outside which run to the teeth of the margin; angle of divergence acute, about 30°; a considerable interval to the next pair of secondaries which leave the midrib at an angle of about 40° and ascend in a slight curve to the margin; the three or four succeeding secondaries on each side become more and more ascending and are unbranched; margin for the basal third entire, upper two-thirds shallow-toothed; nervilles percurrent at right angles to the secondaries; midrib thin and straight. I have tentatively included under this species a leaf from the Montana formation which Knowlton (*loc. cit.*) doubtfully refers to *Viburnum whymperi* Heer, a Tertiary species from which it manifestly differs. It differs from our type in the lower secondaries being sub-opposite and supra-basilar, otherwise it is markedly similar. The genus Viburnum has been heretofore unrepresented in the flora of the ancient Atlantic coastal plain, the species *Viburnum integrifolia* referred by Newberry to this genus being an entirely different leaf. Three species occur in the Patoot beds of Greenland and abundant remains are found in the western interior from the Dakota group upward. Among the twelve species and varieties from the Dakota group only one, *Viburnum sphenophyllum* Kn. resembles the Matawan leaf. From this species ours differs in its larger size, more ovate outline, lesser number of secondaries, which are also more ascending and slightly more curved; the margin is less prominently dentate and the basal third is entire; a pair of secondaries leaves the base at an acute angle; these are wanting in *sphenophyllum* where all the secondaries are parallel, the first pair leaving the midrib 3 mm. above its base at an angle just twice as wide as in our type. In the existing flora the nearest analogues of *Viburnum hollickii* are to be found among the occasional simple leaves of the normally lobed species such as *Viburnum accrifolium* Linn. and *Viburnum opulus* Linn. The normally simple leaved forms have numerous parallel secondaries and more toothed margins although the outline is quite similar in *Viburnum cassinoides* Linn., *Viburnum lentago* Linn., and *Viburnum nudum* Linn.

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[1] Undistributed plates, *XIV.* f. 2. from Dakota group of New Mexico.

[2] *U. S. Geol. Survey*, Monograph 17, 1892, pl. 2, f. 2.

PASSAIC, N. J., July 12, 1903.